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Geology of Beaver Quadrangle

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GEOLOGY OF BEAVER QUADRANGLE.

by

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A

THESIS

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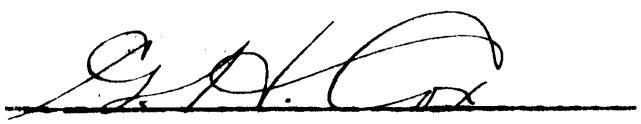
Approved by 

Professor of Geology and Mineralogy.

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INTRODUCTION.

Location and Area.

Beaver Quadrangle lies about three miles southwest of Rolla, in Phelps County, southcentral Missouri. It covers an area of twelve square miles, embracing sections 15 to 22 and 27 to 30, township 37 North, Range 8 West of the fifth Principal Meridian. Its location is outlined by heavy lines on Plate I.

GENERAL RELATIONSHIPS.

Geographically and geologically this Quadrangle forms part of the Ozark Uplift and its general history is the same as that of the province as a whole. The region has been studied and interpreted by various authorities, of which we have referred to the publications of the United States Geological Survey and the Missouri Geological Survey.

The Ozark Uplift embraces some 40,000 square miles in Missouri, Arkansas, Kansas, and Oklahoma, and consists of two distinct divisions, -- the Ozark Plateau to the north, and the Boston Mountains to the south. We are concerned more particularly with the Plateau region which includes all of the Ozark area in Missouri, most

of that in Oklahoma, and a small part in northern Arkansas. It is roughly a broad, flat, elliptical dome with its major axis running northeast and southwest, and reaches a maximum elevation of some 1,700 feet above sea line east of Springfield, Missouri. From here the slope is quite uniform northward to an elevation of about 900 feet above sea level at the Missouri River, with some few indistinct structural ridges and escarpments.

Topographically it is generally considered to form part of an uplifted peneplain in a rather immature stage of dissection. This is evidenced by a fairly even sky-line which truncates the rock strata. The drainage is approximately radial, conforming to the dome structure and with stream valleys usually small and not widely open, separated by fairly broad, gently rolling surfaces. On the north slope the Gasconade River is the largest stream, flowing northward into the Missouri in a valley ten miles or more in width,- much wider than those of the other streams. Although in general conforming to the structure, the streams are governed locally by the lithological character of the rock strata.

The rocks are entirely sedimentary and range in age from Cambrain to Carboniferous. The structure

is simple, the strata dipping gently to the north with minor undulations and some few small faults.

General sections taken across the Ozark Plateau, one north and south, and one east and west, are shown on Plate II, figures 1 and 2.

The history of the north slope of the Uplift is the same as that of the region as a whole. The sediments are practically all of Cambriam age and consist for the most part of limestone and dolomite, interbedded with sandstone and shale. Many of the Cambrian* sediments which underlie the area were laid down under "near-shore" conditions with frequent minor changes in level as shown in the alternations of sandstone, shale and limestone and the presence of ripple-marks, sun-cracks and cross-bedding in some of the sandstones. The Cambrian was laid on igneous rocks, mostly granitic, and probably of Archean age. Following the Cambrian there was a long period of erosion and deposition, but any sediments laid down during this period were eroded before the Carboniferous, when there was considerable deposition, both during the Mississippian and the Pennsylvanian. At the close of the Carboniferous the area was uplifted by a dome-like warp followed by

*Ulrich of the United States Geological Survey has just announced that according to Paleontological evidences these formations are (Ordovician) and are to be classed with the Candian series.

another long erosion period and a peneplain surface was probably developed by the close of the Tertiary. This was followed by another doming and the period of erosion since that movement has carved the present topography.

T O P O G R A P H Y .

Drainage and Relief.

Beaver Quadrangle lies on the east slope of the Gasconade Valley, extending from the top of the divide to a little over one-third the way to the river. The topography is comparatively rough with a general slope to the southwest.

The area is drained by Little Beaver and Beaver creeks and their branches. Little Beaver Creek enters the area about a mile east of the northwest corner and flows southward and westward to a point about a mile north of

the southwest corner of the Quadrangle, where it joins Beaver Creek, which enters the area near the center of the south line and flows northwest to the junction. About an eighth of a mile west of the junction, Beaver Creek empties into Little Piney Creek, which makes a loop into the section at the southwest corner. The main part of the area is drained primarily by Wolf Creek, a branch of Beaver Creek, and an unnamed branch of Little Beaver Creek, both rising near the east line of the Quadrangle and flowing westward to their mouths.

The lowest elevation in the area is about 720 feet above sea level at the junction of Beaver and Little Piney creeks in the southwest corner. From the streams the land rises abruptly on the east to an elevation of about 940 feet and then slopes gently upward to the east in four ridges, rising to a maximum elevation of 1,130 feet near the northeast corner. To the northeast of the Little Beaver there is a flat-topped ridge about three-fourths of a mile long and an eighth of a mile wide at the top, with a maximum elevation of 1,020 feet. To the southwest from Beaver Creek two hills rise to an elevation of 900 feet within this area.

The most noteworthy feature of the topography is the rise and shape of the stream valleys. At the sources of the creeks we find the ordinary precipitous

gulches of head-water topography, but within an extremely short distance the character of the valleys changes abruptly, they becoming wide and flat-bottomed, the streams cutting meandering courses through a heavy residuum of siliceous gravels. It seems hardly possible that such mature valleys could have been formed by such small streams so near their sources by the ordinary process of erosion. It has been suggested that the present drainage has been superimposed upon an older drainage which is primarily responsible for the present topography. This theory assumes that the Carboniferous formations were laid upon an erosion surface which was very similar to the present one, and is based upon the fact that, in nearby areas, the Carboniferous sandstones and shales are found in place, unconformable upon the Jefferson City formation, both on the tops of hills and in the valleys, i. e.; showing the contact between the Carboniferous and the Cambrain to conform remarkably to the topography and indicating a true erosion contact. Since the Carboniferous is not found in place in this quadrangle, no such positive evidence favorable to this assumption can be noted, but, on the other hand, it is true that the Carboniferous residuum is found in this area, not only capping the higher hills, but also uniformly dis-

tributed lower down in the stream valleys than seems naturally explained by the fact of its being so resistant to decomposition and therefore being adapted to considerable transportation.

It has also been proposed that the shape of the stream valleys is due to the checking of erosion by the more resistant layers. This hardly seems to explain the condition fully, in as much as the flat valley floors are found in the soft strata as well as on the more resistant ones, especially in the Gasconade limestone, which is comparatively homogeneous in texture.

While it is impossible to formulate a theory from the study of such a small area, it seems probable that the most potent factor in the formation of the present topography is the chemical solution of the dolomite by meteoric waters rather than the mechanical erosion by the streams themselves. The flat bottoms of the valleys might be explained in part by the protection afforded by the heavy accumulation of resistant residuum of chert and sandstone, which forms a protective blanket for the bottoms of the streams and tends to accelerate lateral cutting.

G E O L O G Y .

Stratigraphy.

The rocks of this quadrangle are entirely of Cambrian* age with the exception of a few small particles of Carboniferous sandstone and shale which occur on the hilltops above and elevation of 1,100 feet, being probable the remains of the old Tertiary peneplain surface. The Cambrain formations exposed in this area are the Gasconade dolomite, the Roubidoux sandstone, and the Jefferson City dolomite.

GASCONADE DOLOMITE.

Only the upper part of this formation is exposed in this area, consisting chiefly of massive, coarsely crystalline dolomite, light yellowish to gray in color and with some thin beds of cherty, arenaceous or calciferous character, which, however, seem to be, for the most part, local.

A partial section of this formation, from the contact with the Roubidoux lower sandstone down some sixty feet, taken along Big Beaver Creek, near the north line of section 30, is as follows:

6	Dolomite, yellow, coarsely crystalline,	5 feet.
5	Dolomite, crystalline, cherty towards bottom	10 feet.

*See foot note on page 3.

4	Dolomite, heavily-bedded, yellow to gray, crystalline and somewhat cherty	10 feet.
3	Dolomite, pinkish gray, coarsely crystalline	20 feet.
2	Unexposed	12 feet.
1	Dolomite, coarsely crystalline	9 feet.

ROUBIDOUX SANDSTONE.

This formation consists of four distinct members, two dolomite, and two sandstone, and has a total thickness of about ninety-five feet.

The lower member consists of about sixteen feet of sandstone in two beds, which show two well-developed systems of joints approximately at right angles, and abundant ripple-marks. It is of uniform texture, disintregrates readily on weathering, and is usually considerably iron-stained, giving it a characteristic red color which shows gray on exposed surfaces due to the leaching out of the iron.

On this lies the lower dolomitic member, consisting of about twenty-six feet of heterogeneous beds principally of cherty, coarsely crystalline dolomites interlaid with cherts and sandy beds, and is of a prevailing light, yellowish gray color.

A section through this member and the lower sandstone of the Roubidoux, taken along the creek in the southwestern part of section 16, is as follows:

Upper Roubidoux Sandstone.

8	Dolomite, thin bedded at top	5 feet.
7	Chert	2 feet.
6	Sandstone	4 feet.
5	Dolomite, coarsely crystalline	4 feet.
4	Chert, decomposed	2 feet.
3	Cherty dolomite, sandy at bottom	5 feet.
2	Dolomite, cherty at bottom	4 feet.
1	Sandstone in two beds, showing well-developed jointing	16 feet.

The upper sandstone member is composed of about twenty-five feet of heavily bedded sandstone, similar in most respects to the lower sandstone, possessing the characteristic color, texture, joints, and ripple-marks, but also showing numerous well-preserved sun-cracks. It is the strongest horizon in the series, showing by far the most persistant outcrop.

The uppermost member has a thickness of about twenty-eight feet and is very similar in character to the lower dolomitic member of this same formation, being composed entirely of alternate beds of cherty and arenaceous dolomites, which show an irregular, thin-bedded, loose shelly structure. A section taken in the cuts along the railroad in the northern part of section 16 is as follows:

Jefferson City, -- Roubidoux contact.

11	Sandstone, residual boulder	1 foot.
10	Residual gravel	4 feet.
9	Thin-bedded, yellowish gray cotton-rock	4 feet.
8	Arenaceous dolomite	1 foot.
7	Thin bedded cotton rock	4 feet.
6	Heavily-bedded dolomite (6 inch to 12 inch beds) with calcite crystals and chert nodules imbedded. sandy in places and also some irregular greenish shale	5 feet.
5	Thin-bedded dolomite with inter-bedded layers of chert	3 feet.
4	Very sandy dolomite	1 foot.
3	Banded dolomite - bands are sandy	1 1/2 feet.
2	Gray crystalline dolomite, cherty and with central bed of cotton-rock and chert	4 feet.
1	Unexposed	2 feet.

Below lies twenty-five feet of heavily bedded sandstone, -- the "Upper Sandstone" member.

JEFFERSON CITY DOLOMITE.

This formation is composed of two distinct members; the "Cotton Rock", and the "Pitted Dolomite." The former is sixty-one feet in thickness, the latter is sixty-five, making a total of 126 feet.

The lower member consists of three strata of

pitted dolomite, of which the lower has a thickness of seven feet, the middle of forty-one feet and the upper of fourteen feet, they being separated by thin layers of cotton-rock. The pitted dolomite, as its name implies, is a comparative, dull gray dolomite having a characteristic cellular structure which gives it a peculiar pitted appearance, especially on weathered surfaces. About twenty-five feet above the contact with the Roubidoux, there occurs a bed of about five feet in thickness of light-colored, coarse, even-grained, loosely cemented sandstone, showing abundant ripple-marks and sun-craks, and which seem to be limited to this area, where it is a distinct and easily recognized horizon for field use. A section taken along the creek in the northeast corner of section 22, is as follows:

8	Cherty cotton-rock	2 feet.
7	Chert and quartzite	4 feet.
6	Oolitic and fragmental	5 feet.
5	Good sandstone, much ripple-marked	1/2 ft.
4	Unexposed	1 1/2 ft.
3	Pitted dolomite (siliceous)	5 feet.
2	Unexposed	8 feet.
1	Pitted dolomite	6 feet.

The upper member is composed of numerous beds of cotton-rock with some sand and shale. The cotton-rock is a soft, fine-grained, even textured, argillaceous dolomitic limestone, varying in color from a dull white to a light yellow, and disintregrates very rapidly upon exposure. The dolomite of this member is rather coarsely crystalline and is generally arenaceous or cherty in character. The cherts occur mostly massive in beds, but also as nodules in the "cotton-rock" and are most abundant near the top and bottom of the "Cotton-rock" section.

CARBONIFEROUS SHALE AND SANDSTONE.

The tops of the higher hills, those reaching an elevation of over 1,100 feet, are capped with a residual of purplish red shales and white sandstone, which has been determined to be of Carboniferous age by fossil remains included where the rocks have been found in place, and which lies unconformably upon the upper Cambrain adjoining areas. This residuum is also found at a lower elevation in the beds of some of the creeks. The sandstone does not show the characteristic red color and ripple-marks of the Roubidoux and is, therefore, usually readily distinguished from it.

RECENT FORMATION.

The recent deposits consist of stream gravels

and alluvium, occuring along the stream beds and on the flood-plains. In the hilly area they consist of residual soils and clays, containing fragments of chert, dolomite, and sandstone derived from the disintegration of the overlying beds.

Structure.

This area being nearly on the top of the structural dome of the Ozarks, the general dip is very slight, averaging about one degree to two degrees to the east.

In the eastern half of the quadrangle there are few strustural features worthy of note, the strata lying in a practically horizontal position with a few slight undulations as shown by small variations in the elevation of outcrops of certain characteristic horizons.

In the western half of the quadrangle the beds have suffered greater deformation as shown by a number of gentle undulation with apparantly no regular stripe.

In general the dip is to the north and east but nowhere do the folds produce a difference in elevation in a given horizon of more than 100 feet. The most conspicuous folding is that shown in a railroad cut in the northeast part of section 20.

In the northwestern corner of section 16, there is a sink about 200 feet in diameter which is probably due to a solution cave in the Gasconade limestone below, into which the Roubidoux has slumped. In this sink there occurs a deposit of iron ore, mostly secondary hematite. Around the circumference the portion of the walls of the sink is shown plainly in places by the large broken masses of Roubidoux sandstone and the pitted dolomite of the Jefferson City in portions clearly indicating that they have fallen into their present position as a result of the slump attendant upon the formation of the sink. The position of the pitted dolomite shows this particularly well, it being present in large blocks with the bedding planes dipping at high angles, and at an elevation below its natural horizon on the nearby hills where the dip is insufficient to produce this change in level.

In the southeastern part of section 20 there is another sink, similar in origin to the one described above, but larger and better developed. Here the ore

which has been mostly mined out, consists of limonite and hematite, secondary after marcasite and pyrite, which were deposited originally in the sink by descending cold solutions, bearing iron sulphates leached from overlying iron bearing formations, no trace of which is now visible. The sink is roughly elliptical in shape, its greatest dimension being about 500 feet from north to south, and probably lies chiefly in the Gasconade dolomite, by the solution of which it was formed, possibly due to the concentration of meteoric waters along the axis of a small syncline as shown by the fact that some of the large outcrops of Roubidoux sandstone around the edge do not have the usual steep inward dip.

HISTORICAL GEOLOGY.

This area has had the same geologic history as the whole region of the Ozark Plateau. During the upper Cambrain period it was covered by a fairly shallow sea and suffered minor changes in level resulting in the deposition of sediments varying from limestone, for the most part, to sandstone and some shales. After Cambrain time the area was alternately sea and land until the Carboniferous period, but any sediments which may have been laid down during this period were eroded before the Carboniferous, so that no trace of them remains today in this particular area. During the Carboniferous period the area was again submerged and sediments were laid down unconformably on the underlying Cambrain. Of these but little remains today, with the exception of the residual sandstone and shale referred to above under Stratigraphic Geology. The area has been land continuously since Carboniferous time. It suffered a considerable uplift and was probably eroded to nearly a peneplain by the Tertiary, which surface is now represented by the flat tops of the hills which occur at an approximately the same elevation. It was then again uplifted and the present surface carved by erosion.

ECONOMIC GEOLOGY.

BUILDING STONE.

Building stone of two kind are found in the quadrangle, -- the pitted dolomite and the Roubidoux sandstone. The pitted dolomite makes an excellent building stone, of good appearance, and has been used successfully in the foundations of some of the buildings of the Schoold of Mines and Metallurgy. Although there are no quarries in the quadrangle, it occurs abundantly.

The Roubidoux sandstone has been used more extensively for side-walks than in buildings, its value for the latter being doubtful. It also occurs plentiful over the area.

The Gasconade limestone, although it has not been extensively used, probably on account of the lack of favorable quarry sites, would seem to be well adapted to building purposes.

IRON DEPOSITS.

In two places in the quadrangle iron has been mined from small sink deposits, the ore consisting of limonite and hematite, secondary after marcasite and pyrite, the hematite being frequently specular in character. Considerable ore was taken from the deposit in section 20, where the operations necessitated the

installation of a pump and mine cars, the ore being taken from an open pit. These deposits are essentially local in character and of small extent and it is improbable that any other deposits occur in the quadrangle, there being no evidence to show other sinks of any importance.

GRAVELS.

Residual gravels are widely distributed over the area but are of a poor quality, lacking any uniformity in size and mixed with soil.

SOILS.

In the stream valleys are found good alluvial soils, while on the flat tops of the hills the soil is usually quite sandy and mixed with chert and gravel. The topography is too rough to permit of extensive farming.

TIMBER.

But little good timber is found in the quadrangle, it being practically all second growth with scrub-oak predominating. Its chief value is for local use, fuel, fence-posts, etc.

WATER.

Good water is everywhere abundant, both in streams and springs and also in wells which need be of but shallow depth. The two chief horizons where springs

occur are, at the top of the pitted dolomite of the Jefferson City formation, and at the top of the Gasconade along the contact with the Roubidoux sandstone above.

The streams are small and intermittent excepting in the western and southern part of the quadrangle, where are found Beaver and Little Beaver creeks with smaller branches fed by springs.

TOPOGRAPHY

STATE OF MISSOURI
BUREAU OF GEOLOGY AND MINES
H. A. BUEHLER, DIRECTOR AND STATE GEOLOGIST

MISSOURI
ROLLA QUADRANGLE

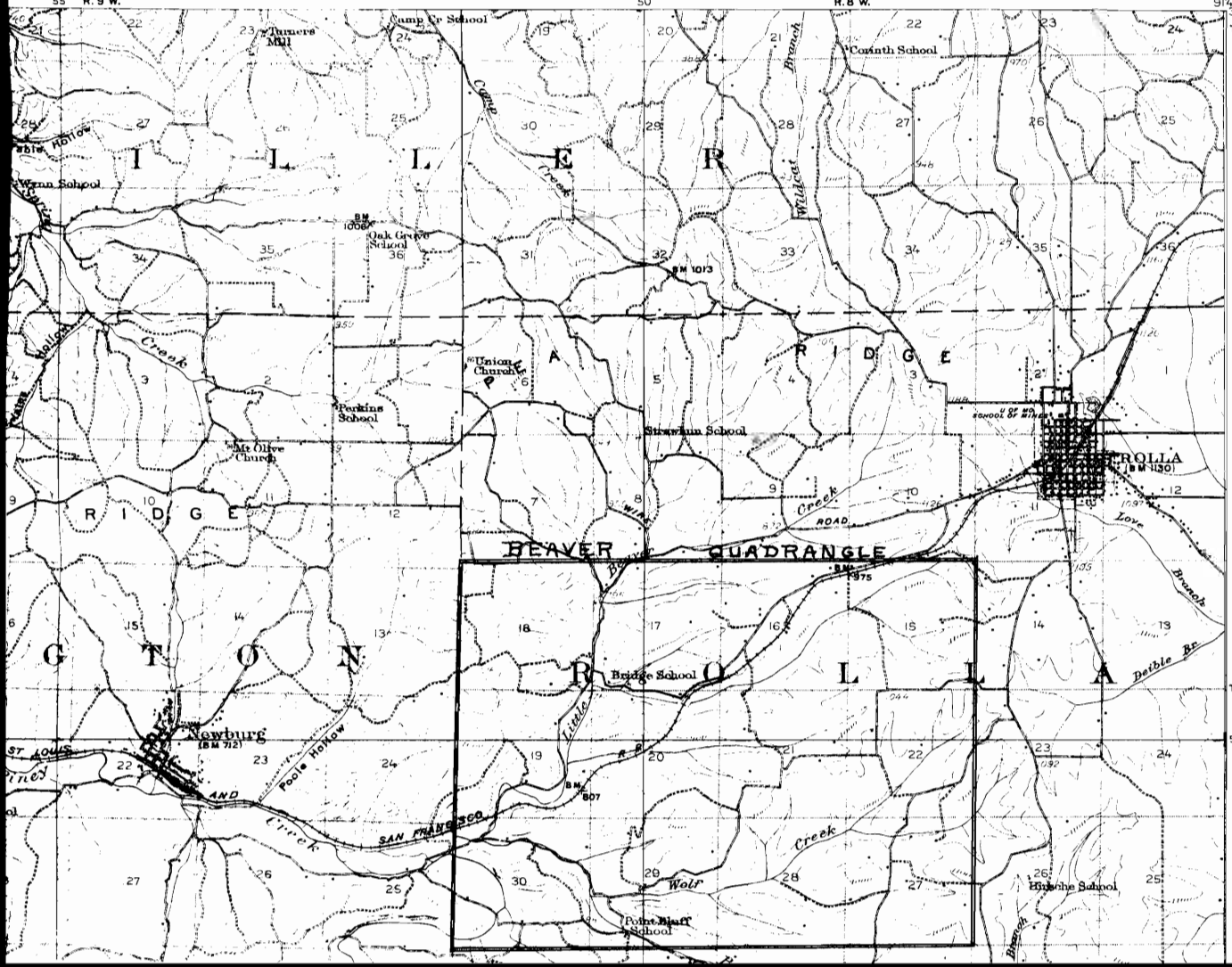
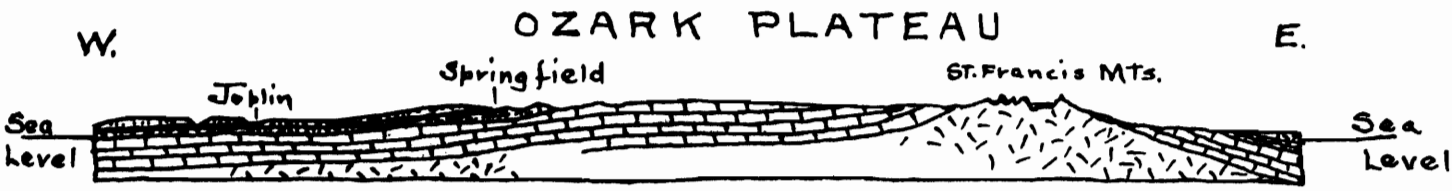


PLATE II.

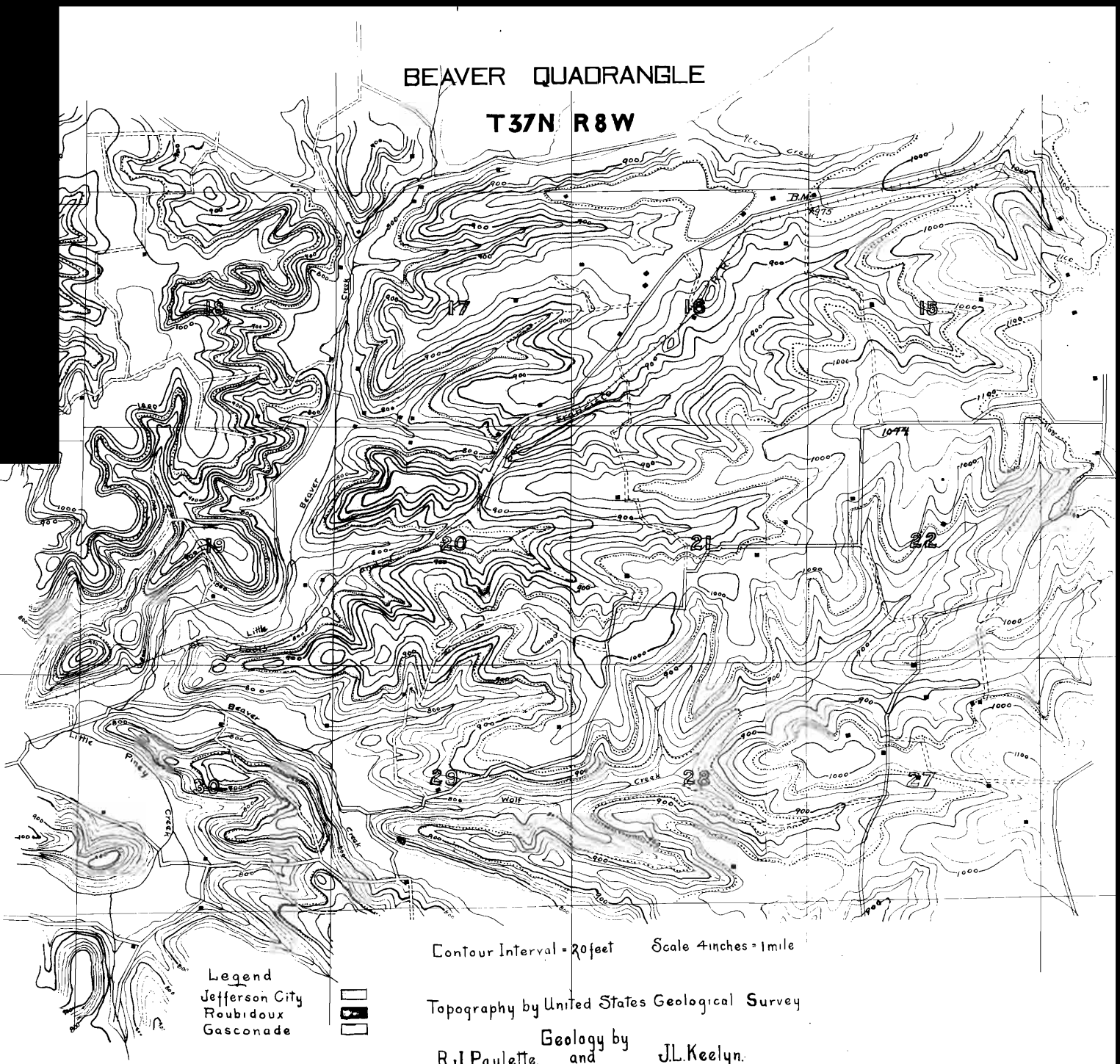
General North - South Section.

Figure 1.



General East - West Section.

Figure 2.


BEAVER QUADRANGLE
T37N R8W
B.M.
975
1077
17
18
15
19
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21
22
29
28
27
30
Beaver Creek
Little Piney Creek
Wolf Creek
Legend
Jefferson City
Roubidoux
Gasconade
Contour Interval = 20 feet
Scale 4 inches = 1 mile
Topography by United States Geological Survey
Geology by
R.J. Paulette. and J.L. Keelyn.